Class/ Index Number /	Centre Number/ 'O' Level Index Number /	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION

SECONDARY FOUR

PHYSICS **6091/03**

Paper 3 Practical **20 August 2024**

1 hour 50 minutes

Candidates answer on the Question Paper.
No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Give details of the practical shift and laboratory, where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
All of your answers should be written in this Question Paper: scrap paper must **not** be used.
Graph paper is provided in this Question Paper. Additional sheets of graph paper should be used only if it is necessary to do so.

You will be allowed to work with the apparatus for a maximum of 55 minutes for each section.
You are expected to record all your observations as soon as they are made.
An account of the method of carrying out the experiments is **not** required.

The use of an approved scientific calculator is expected, where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question. The total number of marks for this paper is 40.

Shift
Laboratory

Examiner's Use	
1	
2	
3	
Total	**40**

This document consists of **14** printed pages inclusive of this cover page.

Section A

1 *In this experiment you will investigate the indentation made by a glass ball in the surface of some modelling clay.*

You have been provided with:

- a glass ball
- two 100 g masses and one 100 g mass hanger
- a 30 cm plastic ruler
- a set square
- a stand, boss, clamp and brick
- a wooden strip (metre rule)
- a piece of modelling clay
- a wooden stand
- a loop of string
- stopwatch

(a) Ensure that the wooden strip is clamped and the clamp is able to rotate freely in the boss.

Place the glass ball and the modelling clay between the centre of the wooden strip and the wooden stand as shown in Fig. 1.1.

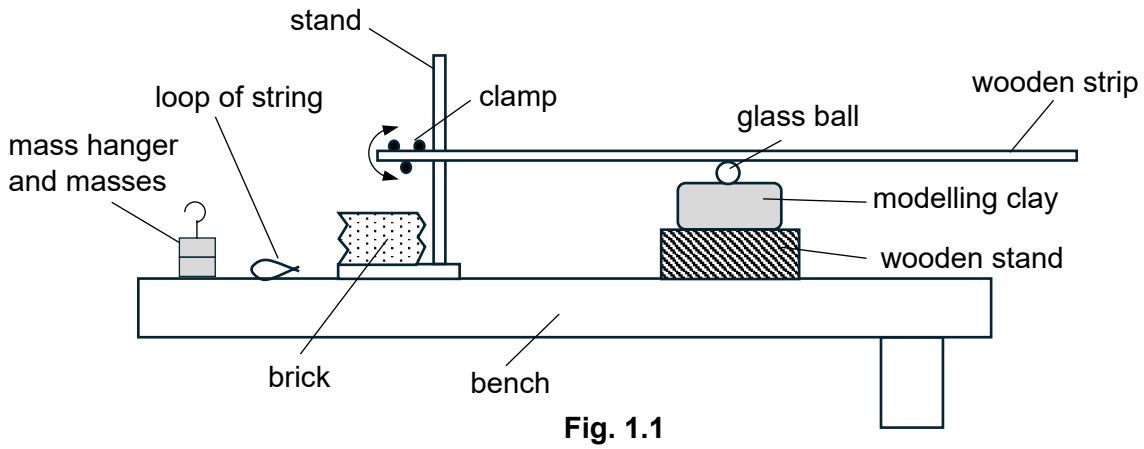

Fig. 1.1

Put the two 100 g masses onto the mass hanger.

The combined weight F_1 of the mass hanger and both 100 g masses is 3.0 N.

Place the mass hanger and masses directly above the glass ball for about one minute.

Remove the mass hanger and masses.

Raise the wooden strip and remove the ball from the modelling clay.

Observe a small circle where the ball has been pressed into the surface of the clay.

This is an indentation.

(i) Measure and record the diameter d_1 of the indentation.

d_1 = ... [1]

(ii) The area of a circle can be calculated using the equation:

$$A = \frac{\pi d^2}{4}$$

where A is the area and d is the diameter of the circle.
Calculate the area A_1 of the indentation with diameter d_1.

A_1 = ... [1]

(b) (i) Replace the ball on a different part of the modelling clay under the wooden strip.

Lower the strip so that it rests on top of the ball.

Using the loop of string, attach the mass hanger and masses near the end of the wooden strip as shown in Fig. 1.2.

Ensure that the wooden strip does not touch the bench top after the mass hanger is loaded.

Measure and record x and y.

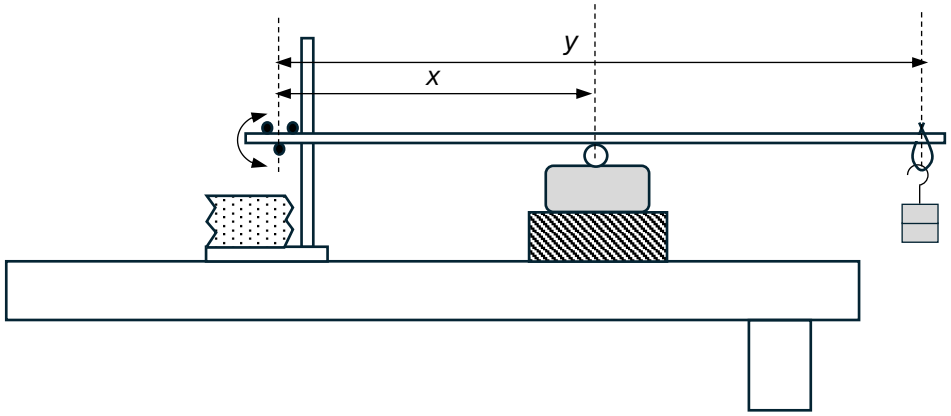

Fig. 1.2

x = ...

y = ...
[1]

(ii) Calculate the force F_2 exerted on the modelling clay using the equation:

$$F_2 = \frac{3y}{x}$$

F_2 = ... [1]

(iii) Measure and record the diameter d_2 of the indentation produced by the ball in the clay.

Using the equation in **(a)(ii)**, calculate the area A_2 of the circle with diameter d_2.

d_2 = ...

A_2 = ...
[1]

(c) Plan

A student claims that F is directly proportional to A.

Plan an experiment to find out if the student's claim is correct.

In your plan, you should:

- state the quantities that you should keep constant
- describe how you will perform the experiment
- explain one precaution that you should take to ensure the accuracy of the experiments
- draw a table, with column headings, to show how to display the range of readings
- sketch the graph that you would obtain if the suggested relationship is correct.

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.....[5]

[Total: 10]

2 *In this experiment you will investigate the rate of cooling of water at the top and at the bottom of a beaker of hot water.*

You are provided with:

- a boss, clamp and stand
- two 250 cm^3 beakers
- a thermometer
- a stop-watch
- a supply of hot water
- paper towels to mop up any water spillages.

(a) Collect about 250 cm^3 of hot water from a dispenser using a beaker. As a safety precaution, **wrap a towel around the beaker** while collecting the hot water.

Pour the collected hot water into the other beaker until it reaches the 200 cm^3 mark on the side of the beaker.

Lower the thermometer into the beaker by adjusting the position of the boss, until the bulb of the thermometer is **just covered by the hot water**.

The arrangement of apparatus is shown in Fig. 2.1.

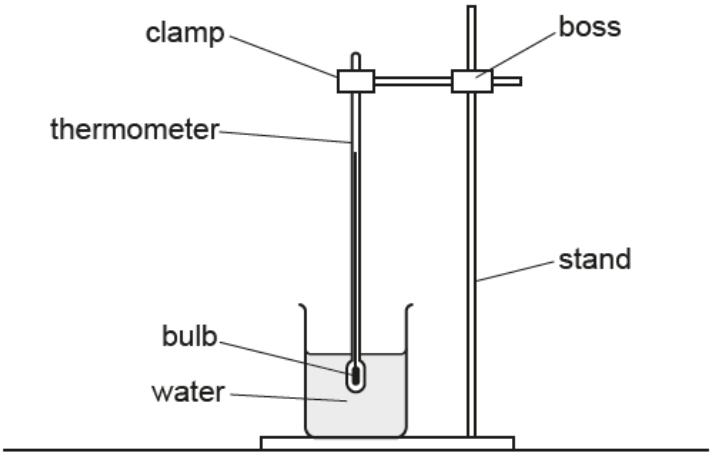

Fig. 2.1

(i) Record the temperature reading of hot water, θ_1, at time t = 0 min.

θ_1 = ... [1]

(ii) Wait for 3 minutes.

Record the temperature reading θ_2 at time t = 3.0 min.

θ_2 = ... [1]

(iii) Other than recording the reading of the thermometer at eye level, suggest another precaution to ensure accurate measurement of the temperature of hot water at t = 0 min.

.....

..... [1]

(b) Remove the thermometer from the beaker and pour the water away.

Pour another 200 cm^3 of hot water into the beaker.

Repeat the procedure in **(a)** but positioning the thermometer lower in the beaker so that the bulb is **just above, but not touching**, **the bottom of the beaker**.

The arrangement of apparatus is shown in Fig. 2.2.

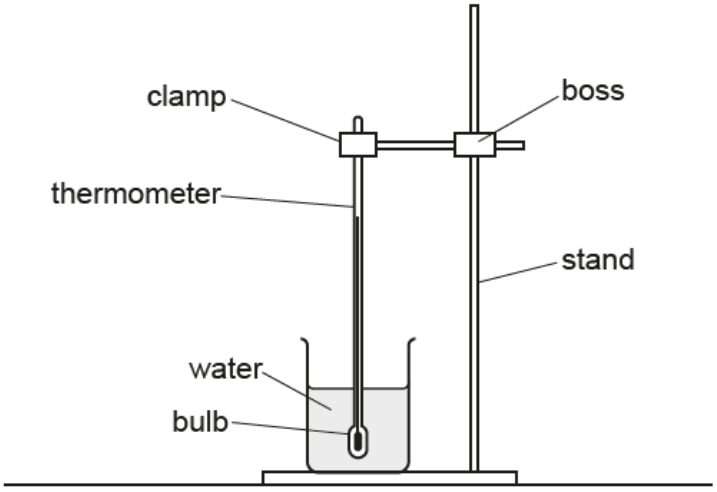

Fig. 2.2

Record the temperatures of the water θ_3 and θ_4 at times t = 0 min and t = 3.0 min respectively below.

θ_3 = ... [1]

θ_4 = ... [1]

(c) **(i)** Calculate the average rate of cooling P_T of the hot water at the top of the beaker.

Use the equation:

$$\text{average rate of cooling} = \frac{\text{decrease in temperature of the water}}{\text{time taken}}$$

P_T = ... [1]

(ii) Calculate the average rate of cooling P_B of the hot water at the bottom of the beaker.

P_B = ... [1]

(d) **(i)** Using your results, suggest why a hot liquid should be stirred before measuring its temperature.

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..... [1]

(ii) Using ideas from *Thermal Processes*, account for the differences in your answers to **(c)(i)** and **(c)(ii)**.

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..... [1]

(e) The experiment is repeated to check the results.

Suggest **two** variables that must be kept constant.

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..... [1]

[Total: 10]

Section B

3 *In this experiment you will investigate the resistance of a solution.*

You are provided with:

- a power supply
- a beaker of water with two wooden rods wrapped in wire
- a voltmeter (0 – 5.00 V)
- an ammeter (0 – 100 mA)
- a switch
- connecting leads
- a small beaker containing 10 m*l* of salt solution
- a syringe
- a stop-watch
- a stirring rod.

(a) Set up the apparatus as shown in Fig. 3.1. Fill the beaker with 200 m*l* of deionized water.

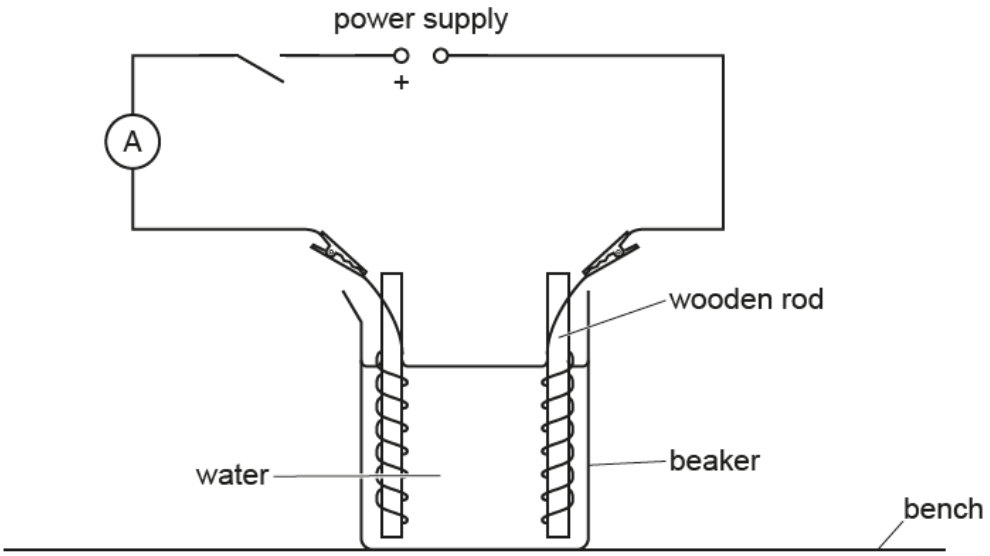

Fig. 3.1

Connect the voltmeter across the terminals of the power supply.

Record the voltage reading *V* on the voltmeter.

V = ... [1]

Remove the voltmeter from the circuit.

(b) Use the syringe to add 1.0 cm^3 (1.0 ml) of the salt solution to the water in the beaker and stir gently.

(i) Record total volume of salt solution, X, in the beaker of water.

X = ...

Close the switch.

After one minute, record the current reading I on the ammeter.

Open the switch immediately.

I = ...
[1]

(ii) The resistance R of the solution is given by the equation:

$$R = \frac{V}{I}$$

Calculate R.

R = ... [1]

(iii) Describe how to use the syringe to add exactly 1.0 cm^3 of the salt solution to the water in the beaker.

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..... [1]

(iv) Suggest why the reading on the ammeter is recorded one minute after the salt solution is added to the water in the beaker.

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..... [1]

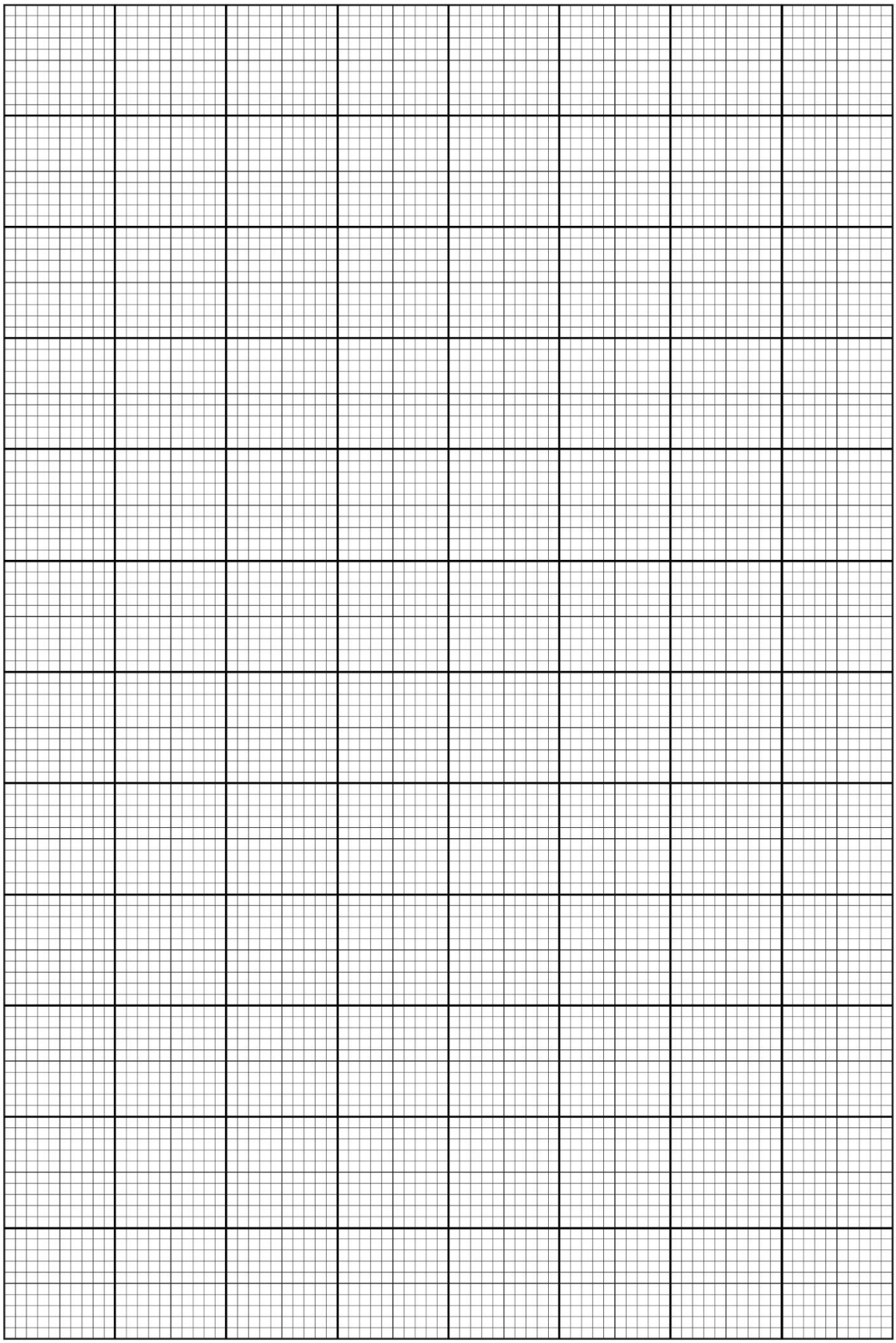
(c) By adding volumes of salt solution to the beaker, repeat **(b)(i) and (b)(ii)** for additional values of *R*.

Assume that the voltage *V* across the terminals of the power supply recorded in **(a)** remains unchanged throughout the investigation.

Record your values for X, I and *R* in a table. Also include your result from **(b)** in the table.

[4]

(d) Using the grid on page 13, plot a graph of *R* against X. [4]



(e) **(i)** Draw a tangent to the curve at X = 4.0 cm^3.

Determine the gradient *G* of this tangent.

G = ... [2]

(ii) Explain the trend in your graph.

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…….. [1]

(iii) Water provided in **(a)** at the start of the experiment is deionized, to remove the charged ions in it.

If the experiment is repeated using tap water instead of deionized water, sketch and label a line "Z" on the grid on page 13 to represent the expected results.

[1]

(f) Describe **three** improvements to the experiment to obtain an accurate value of *R*.

1 ……..

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2 ……

…….

3 ……

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[3]

[Total: 20]